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Is There Learning from Exporting? Firm-level Evidence from Latvia

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Is There Learning from Exporting? Firm-level Evidence from Latvia[1]

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Abstract

This paper examines the link between innovativeness of firms and their export market participation. Using a unique dataset of Latvian firms, we analyze the direction of causality between innovation and exports, including both overall exports and exports to particular destinations. To do this, we instrument innovativeness using a set of answers to survey questions regarding the importance of various sources of knowledge for innovation. At the same time, we use the ethnicity of the largest owner as instrument for exports, reasoning that firms owned by members of ethnic minorities are more likely to export, while members of the majority group may find it easier to find clients domestically. The results, robust to a variety of specifications, find a positive and statistically significant effect of innovativeness on exporting. This effect is different for different export markets. However, we find no evidence of a positive effect of exports on innovation.

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Non-technical summary

A large number of studies in international trade demonstrate that exporting firms are substantially different from the firms that supply only the domestic market. In particular, it has been found across a wide range of countries and industries that exporters tend to be more productive than non-exporters. However, the underlying relationship between export orientation and productivity is still far from being completely clear.

One line of theoretical reasoning suggests that entering export markets is associated with substantial sunk costs. Thus, more productive firms have an advantage on the export market, and hence they self-select into exporting. Another line of thought proposes the reverse causality, i.e. that firms improve their productivity by exporting, for instance, by exchanging knowledge with foreign clients ("learning-by-exporting"). Actual empirical evidence on the direction of causality has been mixed.

Since innovation is one of the major factors leading to higher level of productivity of firms, a similar debate has emerged on the link between innovativeness and export orientation. As before, it has been found that innovativeness is associated with greater degree of export market participation, but no conclusive evidence has been found on the direction of causality, with different studies pointing to the presence of self-selection, learning-by-exporting, or both effects.

In this paper, we try to contribute to the discussion on the direction of causality between innovativeness and export orientation. To do this, we perform instrumental variable estimation on a cross-sectional data of firms. First, we estimate the effect of innovativeness (which we measure as the share of sales from innovative products in total sales) on export intensity (measured on the share of exports in sales). We instrument innovativeness using a set of variables describing the importance of various sources of information relevant to innovative activities. We also disaggregate the overall exports into exports to specific markets – namely, to Estonia and Lithuania, to other EU countries, and to the countries of the Commonwealth of Independent States – to look at the effect of innovativeness on exports to particular destinations.

Second, we examine the impact of exporting on innovativeness. We use ethnicity of the largest owner to instrument export intensity. We reason that firms whose owners belong to minority groups are more likely to export because they may have stronger cultural and linguistic links with countries of export destination. On the opposite, for members of the majority group it is likely to be easier to find buyers on the domestic market.

This paper uses the Survey of Innovative Businesses in Latvia (SIBiL) to study the relationship between owner's human capital and firm level innovations. SIBiL is a novel micro-level dataset covering a wide range of innovative activities of 1251 small Latvian firms in 2007-2008. The sampling design of SIBiL is very similar to Community Innovation Survey (CIS), the main instrument for measuring firm-level innovations in the European Union. The questionnaire and the sampling method of SIBiL are nearly identical to those of the CIS. However, SIBiL has a number of important advantages. First, SIBiL complements CIS by focusing on small firms with less than 50 employees. In contrast, the CIS does not cover firms with less than 10 employees. Second, SIBiL is conducted using face-to-face interviews with owners and managers of the companies, which is a more reliable method compared with the mailed questionnaires used by CIS. All the interviews were conducted by *Latvian Facts*, a professional survey firm. Third, SIBiL has a substantially larger questionnaire, covering the areas of access to and the use of external financing, business strategy, and background of the owners, such as their human capital and prior professional experience. Fourth, SIBiL specifically focuses on sectors that EuroStat classifies as high-technology manufacturing and knowledge intensive services. About 35% of the firms in the sample operate in these sectors. Fifth, our survey data are merged with the financial and ownership data from the Business Registry.

Overall, our analysis suggests that innovativeness has a positive and statistically significant causal effect on exports, controlling for firm size, age, number of owners, industry and other important factors. The result is robust to a variety of different specifications, including a change in the definition of instruments, replacement of the set of instruments with alternative ones, and restriction of the sample

to firms with a non-zero amount of innovation. At the same time, we find that our set of instruments is both valid and rather strong.

These findings provide support for self-selection mechanism as a tool to explain the link between exports and innovation. We also find that foreign-owned firms, as well as firms of larger size (measured as the number of employees) tend to export more.

Furthermore, we find that the effect of innovativeness is different for exports to different destinations. Exports to countries of European Union or Commonwealth of Independent States are far more sensitive to innovativeness than sales to Latvia's neighbour countries Lithuania and Estonia. This implies that self-selection is especially important for EU and CIS markets, perhaps because of higher fixed costs associated with entering these markets.

At the same time, we find no evidence of a positive effect of exports on innovations. On the contrary, the effect appears to be negative; it is, however, only significant on the margin. This provides no support for the "learning-by-exporting", the second possible explanation of the association between innovativeness and export orientation.

1. Introduction

In recent years, studies in international trade have increasingly focused on explaining heterogeneity of firms with respect to their export activities. Not all firms engage in international trade, and the firms that do export are different from those that do not. In particular, most of existing research suggests that exporters tend to exhibit higher levels of productivity (see reviews by Tybout, 2003, and Greenaway and Kneller, 2007). Two lines of theoretical reasoning have been developed to explain this observation. The first approach, developed in papers such as Bernard et al (2003) and Melitz (2003), suggests that the difference in productivity exists even before exporting begins. Sunk costs associated with entering export markets lead to self-selection of the most productive firms into exporting. The second line of thought suggests the reverse causality, i.e. the firms improve their productivity by exporting, for instance, by using commercial interactions to exchange ideas and increase the stock of knowledge (Grossman and Helpman, 1991). Empirical studies have been largely supportive to the former approach,[5] although the learning-by-exporting hypothesis has also found some empirical evidence.[6]

At the same time, researchers have also been interested in the factors that lead to the higher level of firms' productivity. In this regard, much attention has been drawn to innovative activities of firms, and to the impact of these activities on exports. It has been found that, just as in the case of productivity, innovation is associated with higher levels of export participation.[7] Efforts have been made to determine whether innovations cause exports or vice versa, but with mixed results.[8]

In this paper, we analyze the causality between innovativeness and export orientation of firms. For this reason, we address three questions. First, does innovation cause firms to export more? Second, is there a difference in the effect of innovativeness on exports to different destinations? Third, does exporting encourage firms to be more innovative?

To answer these questions, we use instrumental variable techniques. Our main measure of innovativeness is the percentage of sales generated by innovative products (new to the firm but not necessarily new to the market). Export-orientation of the firm is measured as a share of exports in total sales. First, we estimate the effect of innovativeness on exports – both overall exports and exports to different markets. We use sources of information relevant to innovative activities as instruments for our

[5] Papers that have found support for the self-selection hypothesis include Roberts and Tybout (1997), Clerides et al (1998), and Bernard and Jensen (1999).
[6] Baldwin and Gu (2003), Girma, Greenaway and Kneller (2004), and Kraay (2006) concluded that learning-by-exporting is present.
[7] Wakelin (1998), and Cassiman and Golovko (2007) are among the examples of studies that reach this conclusion.
[8] Some of the papers that find evidence of self-selection of innovative firms into exporting are Ebling and Janz (1999), and Becker and Egger (2007). Damijan et al (2008), on the other hand, conclude that learning-by exporting is present. Lachenmaier and Woessmann (2006), Smith et al (2002), and Girma et al (2008) point to the existence of both effects.

measure of innovativeness. Second, we examine the reverse effect that export activities may have on innovativeness of firms. We use ethnicity of the largest owner of a firm to instrument our measure of export orientation. There are reasons to believe that the owners belonging to minority groups are more likely to export. Ethnic minorities may have stronger cultural and linguistic links with countries of export destination. On the opposite, members of the majority group find it easier to operate on the domestic market. The choice of instruments is explained in more details in Sections 2.2 and 2.3.

This paper uses the Survey of Innovative Businesses in Latvia (SIBiL) to study the relationship between owner's human capital and firm level innovations. SIBiL is a novel micro-level dataset covering a wide range of innovative activities of 1251 small Latvian firms in 2007-2008. The sampling design of SIBiL is very similar to Community Innovation Survey (CIS), the main instrument for measuring firm-level innovations in the European Union. The questionnaire and the sampling method of SIBiL are nearly identical to those of the CIS. However, SIBiL has a number of important advantages. First, SIBiL complements CIS by focusing on small firms with less than 50 employees. In contrast, the CIS does not cover firms with less than 10 employees. Second, SIBiL is conducted using face-to-face interviews with owners and managers of the companies, which is a more reliable method compared with the mailed questionnaires used by CIS. All the interviews were conducted by *Latvian Facts*, a professional survey firm. Third, SIBiL has a substantially larger questionnaire, covering the areas of access to and the use of external financing, business strategy, and background of the owners, such as their human capital and prior professional experience. Fourth, SIBiL specifically focuses on sectors that EuroStat classifies as high-technology manufacturing and knowledge intensive services. About 35% of the firms in the sample operate in these sectors. Fifth, our survey data are merged with the financial and ownership data from the Business Registry. Summing up, SIBiL provides unprecedented wealth of data on the activities aimed at the production, use, and acquisition of knowledge within small firms. What makes our data unique is that it has detailed information on personal backgrounds of the owners of small firms. A substantial number of studies merged Community Innovation Surveys with the data on firms from Business Registries or other official sources. However, to the best of our knowledge, there is no study that tried to link CIS data to the personal background of owners.

The main finding of this paper is that innovativeness has a positive and statistically significant effect on exports, which is robust to a variety of specifications. The effect differs for different export destinations. However, we find no evidence of a positive effect of exports on innovations.

The rest of the paper is structured as follows. Section 2 explains our empirical strategy, justifies the choice of instruments and describes the measurement of variables. Section 3 presents the source of data, while Section 4 provides some descriptive statistics. In Section 5 we report the results. Finally, the last section concludes.

2. Methodology

In this section, we present the empirical strategy for estimating the effect of innovativeness on export intensity, and the reverse effect of export intensity on innovation. In doing this, we test two hypotheses. The first hypothesis states that innovative activities cause firms to export more intensively. This hypothesis corresponds to the view that innovating firms self-select themselves into exporting. The second hypothesis suggests that export activities cause firms to innovate more. Evidence in support of this hypothesis will lead to conclusion that learning-by-exporting takes place.

We use the share of exports in overall sales as our main proxy for export-orientation of firms. The innovativeness is measured as the share of total sales generated by innovative products. The measurement issues of endogenous as well as exogenous variables used in the regressions are explained in more detail in Section 2.4.

2.1 Estimation strategy

Consider the following simultaneous equations model:

$$Exp = f^{exp}(Inn, X) \quad (2.1)$$

$$Inn = f^{inn}(Exp, X) \quad (2.2)$$

where *Exp* is the measure of export-orientation of the firm, *Inn* is the measure of innovativeness, and *X* is a vector of control variables. We begin by estimating the model in a linear form. Specifically, to estimate equation (2.1), we formulate the following model:

$$Exp = \beta^{exp} Inn + \gamma^{exp} X + u^{exp}, \quad (2.3)$$

where u^{exp} is a disturbance term. To account for the likely simultaneous causality between exports and innovation, we instrument *Inn* with a set of variables describing the effect of sources of information on innovation. Equation (2.2) is similarly estimated in a linear form, and a set of variables describing the ethnicity of the largest owner is used to instrument *Exp*. The choice of instrumental variables and discussion of their validity is presented in Sections 2.2 and 2.3.

However, the linear model ignores the fact that the left hand side variables are not normally distributed. Both *Exp* and *Inn* represent the percentages of firms' sales generated by exported goods and by innovative products, respectively. This is reflected in the data: a substantial proportion of firms report no exports at all, and a smaller but still sizeable number of enterprises exports all of their

products. A similar situation is observed in the data on sales from innovative products (see Figure 1 and Figure 2).

[Insert Figure 1 and Figure 2]

The restricted range of each of the dependent variables, coupled with the fact that the data appears to be clustered around the upper and lower limits of this range, points to the presence of data censoring. If this is the case, fitting a linear model does not produce consistent estimates. To address this problem, we modify the model to account for data censoring in the second stage. Specifically, to estimate equation (2.1), we employ the following instrumented version of the Tobit model:

$$Inn = \beta^{inn} Exp + \gamma^{inn} X + u^{inn} \quad (2.4)$$

$$Exp^* = \beta^{exp} Inn + \gamma^{exp} X + \delta^{exp} Z^{exp} + u^{exp} \quad (2.5)$$

$$Exp = 0 \text{ if } Exp^* \leq 0$$
$$= Exp^* \text{ if } 0 < Exp^* < 100$$
$$= 100 \text{ if } Exp^* \geq 100$$

where Exp^* is the latent preferred levels of export intensity, Exp is the observed value of the share of exports in sales, and Z^{exp} is a vector of instruments for export intensity. A similar model is constructed to estimate the effect of exports on innovativeness.

2.2 Choice of instruments for innovativeness

To instrument our measure of innovativeness, we use the degree of importance of various information sources for firms' innovation activities reported in the survey. Specifically, we use the following sources of information:

- Family or friends;
- Sources within your enterprise or enterprise group;
- Suppliers of equipment, materials, components, or software;
- Consultants, commercial labs, or private R&D institutes;
- Universities or other higher education institutions;
- Government or public research institutes;
- Conferences, trade fairs, exhibitions;
- Scientific journals and technical publications;
- Professional and industrial associations;

- New employees.[9]

The survey design is such that the question on information sources relevant for innovation activities is asked only if a firm has had any kind of innovation activities over the period from 2005 to 2007. [10] For non-innovating firms, the sources of information are assumed to be irrelevant for innovation activities. As an approximation, this seems reasonable, as it is difficult to see why non-innovating firms would perceive any sources of information to have any effect on their (non-existent) innovative activities. We also check the robustness of our results to this assumption by performing the estimation on a sample of innovative firms only.

The use of instrumental variables entails concerns about the instrument strength and exogeneity. The former issue is addressed by the design of the survey question, which specifically ask about the effect of particular factors on innovation activities. Also, the equation is overidentified, with many instruments for one endogenous variable. As noted by Chao and Swansson (2004), using a large number of instruments is one way to improve the reliability of point estimates even when individual instruments are weak. Another way of reducing the threat that weak instruments may potentially pose to the analysis is to use the limited information maximum likelihood (LIML) estimation, instead of the more commonly used least squares. As noted by e.g. Chao and Swansson (2004) and Hahn, Hausman, and Kuersteiner (2002), LIML estimator is less biased in case of weak instruments than the least squares.

As regards instrument exogeneity, there are two reasons why information flows should not affect exports directly, except through innovativeness. First, it is doubtful that information flows from family or friends, universities, scientific journals, government, and other sources that are unrelated to the potential export markets can have an effect on a firm's ability to export. Second, even when this effect may possibly exist, we can plausibly assume that it is not captured in our data, because the question specifically asked the respondents to evaluate the impact of these factors on the firm's innovation activities, not their importance per se. Several additional methods are employed to ensure instrument validity. First, we utilize the commonly used Hansen's J-test of overidentifying restrictions. Second, we check whether the estimation is robust to replacing the set of instruments with an alternative set.

[9] There were two other potential sources of information listed in the questionnaire: "clients or customers" and "competitors or other enterprise in your sector". We do not use these two sources of information as instruments for innovations because the degree of importance of these factors may be related to export activities in the firm. Thus, these variables are probably not exogenous in the export equation and can serve as valid instruments.

[10] Innovation activities include introduction of product innovation, process innovation or any other ongoing or abandoned innovation activity (e.g. acquisition of machinery, equipment, software, licenses; engineering and development work, training, marketing, R&D, etc.) specifically undertaken to develop or implement product or process innovation.

As an alternative set of instruments we use a set of dummies showing the degree of influence of different obstacles to innovation on innovative activities of firms. The following obstacles are used:

- lack of qualified personnel;
- lack of information on technology;
- difficulty in finding cooperation partners for innovation;
- uncertain demand for innovative goods or services.

The survey also contained other potential obstacles to innovation (see Appendix A). They were not included in the set of instruments, because their exogeneity is questionable. In particular, the obstacles related to lack of finance are likely to affect both innovation and export activities. Similarly, factors such as "lack of information on markets" or "markets dominated by established enterprises" could affect export behaviour of firms. Finally, factors such as absence of a need to innovate may indicate both an unwillingness to be innovative and a fact that the firm is already sufficiently innovative; thus, these factors do not unambiguously point to obstacles to innovation.

Another potential problem comes from the fact that both sets of our instruments are based on variables that express subjective opinion of respondents. Therefore, there is a possibility of bias inherent in such survey responses. It is possible that firms are unable to properly assess the relative importance of each particular source of information or obstacle to innovation – or that different firms perceive importance differently, making it impossible to compare responses across firms. To check the robustness of our estimates against this threat we follow the method suggested by Criscuolo et al (2005). We assume that even if firms are unable to measure consistently the relative importance of each factor, they are still capable to say whether this factor had played any role at all for their innovative activities. In order to circumvent the potential heterogeneity of firms in their assessment of importance of a particular factor we use an alternative definition of instrumental variables. This definition is explained in Section 2.4.

2.3 Choice of instruments for export intensity

Our instrument for export intensity is the ethnicity of the largest owner. Latvia is a multiethnic country with a substantial proportion of Russian population. According to Latvia's Central Statistical Bureau, ethnic Russians mad 28% of the population in 2008, and another 10% were classified as "other" (predominantly Russian-speaking) minorities. Moreover, in Riga, where 65% of the firms in our sample are registered, minorities outnumber ethnic Latvian population (58% vs. 42%). A similar situation is observed in a number of other big cities.

There are two reasons why ethnicity of owners may affect export orientation of the firm. First, firms whose owners or managers belong to ethnic minorities may face a lower cost of establishing

business relations with partners from certain foreign countries, due to personal or family ties, cultural similarity, etc. In fact, studies that estimated the gravity model of international trade generally find that measures of cultural proximity (e.g. linguistic or ethnic similarity) have a substantial effect on the amount of bilateral trade (see Frankel, 1997 for a review). If this is the case, we can expect higher export intensity of the firms with non-Latvian owners[11]. Ethnic Russians or members of other Russian-speaking groups have advantage of cultural proximity to Russia or other CIS countries and are likely to export a greater share of their products to these destinations.

Second, for the firms with ethnic Latvian owners it may be easier to find buyers within Latvia, because of similar cultural factors or possible favoritism in public procurement. According to Eurostat data, public procurement in Latvia was 13.8% of Latvia's GDP in 2006. This is the highest estimate among all EU member states and it is four times higher than the average estimate for EU-25. There is substantial anecdotal evidence of corruption in public procurement in Latvia. Given difficulties with enforcement of contracts, corruption in public procurement is likely to be based on personal relationships, where ethnicity might play a substantial role. Almost 70% of people employed in public sector in Latvia are ethnic Latvians. In the capital dominated by minority population this percentage is still above 60%. This is by 20 percentage points more than the share of ethnic Latvian population in private sector and larger than the percent of ethnic Russians employed in public sector more than by a factor of two.[12]

Ethnicity of the largest owner serves as a valid instrument for export-orientation only if there is no correlation between ethnicity and the disturbance term in the innovation equation. One conceivable way how this correlation might be present is via education level of the owner. If members of some ethnic groups have better access to education they are likely to have better opportunities to innovate. To avoid this problem, we control in our regressions for education level of the largest owner of the firm.

By using as an instrument only the ethnicity of the largest owner we disregard a possible effect of ethnical background of other owners. To test the robustness of our results to this assumption we estimate the model on a reduced sample of sole owners only.

2.4 Measurement

Both endogenous variables are based on the survey responses. The exact questions are reported in Appendix A. As the main measure of export-orientation we use the share of exports in overall sales

[11] Global Entrepreneurship Monitor surveys in Latvia (2006-2008) suggest that the percentage of exporters is higher among entrepreneurs of Russian or other ethnicity than among ethnic Latvians. These conclusions are drawn on a sample of 150-200 entrepreneurs identified through screening of a random sample of population.
[12] Based on Labour force surveys in Latvia (2004-2005), own calculations.

over the last two to three years of operation. This is a traditional measure used in many studies, e.g. Grubel et al (1967) at the industry level, Wakelin (1998) at a firm-level. We also use the shares of firm' exports to specific destinations: the two Baltic States (Estonia and Lithuania), other countries of the European Union, and countries of the Commonwealth of Independent States[13]. The measure of innovativeness of firms is the share of total sales in 2007 generated by innovative products introduced during 2005-2007. In this definition we include completely new or significantly improved goods or services novel to the enterprise but not necessarily new to the sector or to the market. This is one of the definitions used in Community Innovation Surveys as a measure of innovativeness of firms.

This paper focuses on firms with product innovation only, because the data provides a more informative measure of innovativeness of these firms, namely the share of sales from innovative products. We consider this measure to be a proxy for the degree of innovativeness of firms. In our definition of innovativeness we disregard the firms with process innovation or ongoing or abandoned innovation activities. If product and process innovation are considered together the definition becomes rather broad and almost three quarters of the firms in the sample are innovative.

SIBiL data provides many alternative measures of innovativeness of firms. We use a direct measure of the output of innovation activities – product innovation. Although this measure is based on a subjective assessment (which might be a problem if a measurement error is correlated with an error term), this definition has a number of advantages over other frequently used measures, like patents or R&D expenditures. It is widely acknowledged that a lot of innovations are never patented or even patentable, while at the same time many patents are related to innovations which have not been introduced into the market. Particularly in case of small firms the measures of innovativeness based on R&D expenditures can be seriously biased, because many of the firms do not have a special R&D budget or department and therefore can not measure R&D expenditures precisely. Measure of product innovation captures innovations that have not been patented and innovations which have been introduced outside R&D departments.

To instrument the share of sales from innovative products, we use two alternative sets of instruments. The first set consists of firms' responses to a series of questions on the importance of various information sources for their innovation activities. The second contains assessment of influence of different obstacles to innovation on innovative activities of firms. The exact questions used in the survey are reported in Appendix A.

Both the importance of information sources and obstacles to innovation is assessed using four point scale (1 – high importance, 2 – average importance, 3 – low importance, 4 – not relevant). For each factor (a source of information or an obstacle) we compute three dummy variables indicating that

[13]Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.

the degree of importance of this factor was high, medium or low, using category "not relevant" as a reference group. In total we have 30 dummy variables in the first set of instruments and 12 in the alternative set of instruments. We also use an alternative way to define instrumental variables suggested by Criscuolo et al (2005). We replace three dummies (for high, medium or low importance of a particular factor) by a single dummy that equals one if the factor is relevant for the firm and zero otherwise.

To instrument export intensity of firms we use ethnicity of the largest owner. The survey includes information on demographic characteristics of the three largest owners of a firm. Since most firms in the sample are small, it is reasonable to expect that the largest owner either participates directly in managing the company, or else has a substantial influence over it. Moreover, about half of the firms in our saample have a sole owner. Thus, ethnicity of the largest owner should play an important role for export decisions of firms and intensity of export to specific destinations. In the question on ethnicity respondents had to choose between three options: ethnic Latvian, ethnic Russian, or other ethnicity. Thus, the set of instruments for exports consists of two dummy variables for Russian ethnicity and for other ethnicity, with ethnic Latvian being a reference group.

Our set of control variables includes size of the firm, age of the firm, number of owners, education level of the largest owner, controls for foreign owners and for the largest owner being a legal person, and industry dummies.

Information on size of the firm and age of the firm are extracted from the data in the Business Registry. Size of the firm is measured as a number of employees in 2007. We expect size to have a positive effect on export intensity if there are fixed costs associated with entering export markets. To account for non-linear effect of size we include number of employees in linear as well as in quadratic form. Similar relationship is expected for innovative firms.

Age of the firm is computed as a number of years since registration. The relationship between age of the firm and its export intensity is theoretically ambiguous. According to the Process Theory of Internationalization (developed by Johanson and Vahlne, 1977) firms gradually increase their international involvement by accumulating knowledge on foreign markets because early and rapid internationalization is risky for firm's survival. On the contrary, a more recent theory of International New Venture (by Oviatt and McDougall, 1994) suggests an early internationalization, which is a prerequisite for firms' growth.

We include number of owners as a control variable, because we expect that the firms with multiple owners may have certain advantages over the firms with sole owners in terms of having more human capital or more diverse human capital, more social connections, better access to financial resources etc. We include a dummy variable for the firms with two owners and a dummy for three

owners and more (sole owners leaving as a reference category). The variable is based on the information reported by respondents in the survey.

Education of the largest owner is also derived from the survey responses. We distinguish three levels of education: secondary general or less, secondary professional and higher education (bachelor, master or doctoral degree). Secondary professional education serves as a reference category.

Business Registry data provides information on whether among the owners there is a person of foreign nationality. We use a dummy variable to control for presence of at least one foreign owner.

An owner can be either an individual or a firm. Since we use personal characteristics of the largest owner in our model we also control with a dummy variable for the cases when the largest owner is a legal person. If this is the case, all dummy variables describing demographic characteristics of the largest owner are coded as zeros.

Industry dummies are based on the same industry groups that were used to form strata in a sampling strategy (for more information see the next Section). In total 20 groups for different industrial sectors are formed with broader categories for traditional sectors and more detailed one for high-technology sectors.

3. Survey of innovative businesses in Latvia (SIBiL)

This section describes a novel dataset on innovative behavior of small firms in Latvia that is used in this study. It discusses the similarities and differences between the Survey of Innovative Firms in Latvia. SIBiL and major existing datasets, the sampling strategy, design of the questionnaire, and results of the first wave of the survey.

SIBiL combines elements of a number of leading firm level surveys with Business Registry data on 1,254 small Latvian firms, provided by *Lursoft LLC*. The survey part of SIBiL borrows from EuroStat's Community Innovation Surveys (CIS), Panel Study of Entrepreneurial Dynamics (PSED)[14], U.S. Federal Reserve Survey of Small Business Finance, and Djankov et al (2005) survey of entrepreneurs in Russia, Brazil, China, and India. The first wave of the survey was conducted in 2007-2008 by *Latvian Facts*, a premier market research firm, using face-to-face interviews. Then, the survey data were merged with the Business Registry data in 1996-2007.

SIBiL is highly similar to Community Innovation Surveys, which are used to measure innovations in OECD and EU countries (OECD 2005). It uses the same questionnaire as the 4th wave of CIS and covers the same industries. However, compared to the CIS, SIBiL has a number of important advantages. First, SIBiL relies on face-to-face interviews with owners-managers of firms, as opposed to mailed questionnaires typically used by the CIS. Second, SIBiL's target population is small firms with

[14] PSED2, Wave B, Survey Research Center at the University of Michigan.

less than 50 employees.[15] In contrast, CIS typically covers firms with more than 10 employees. Thus, SIBiL complements CIS by covering micro-firms with less than 10 employees. Third, SIBiL ensures there is a sufficient representation of firms in high-technology manufacturing and knowledge intensive services, as classified by the Eurostat. Using NACE Revision 1, these are manufacture of aerospace (35.3), computers (30), electronics and communications (32), pharmaceuticals (24.4), scientific instruments (33), post and telecommunications (64), computer and related activities (72), and research and development (73). Fourth, SIBiL goes at great length to ensure accurate measurement of firms' innovations activities. By using the data on owners from the Business Registry, we make sure that the interviews are conducted with owners-managers of the firms. In contrast, usually it is not known who is filling out the mailed questionnaires.[16] Also, an important drawback of mailed questionnaires is that they may not provide respondents with a good idea of what is a product innovation.[17] An advantage of SIBiL is that the interviewers were trained to help the respondents with specific examples of product and process innovations in the respondent's industry.

The sampling strategy is also similar to the Community Innovation Surveys. The target population consisted of active firms with less than 50 employees in 2006 as well as firms that were first registered in 2007.[18] The sampling frame is based on the Business Registry, which excludes entities that are not obliged to submit financial reports, such as self-employed, farmers' cooperatives, etc. The industries that are covered in the survey are in the first column of Table 1. The second column provides the NACE codes of these industries.

The target population is broken down into 40 strata, formed by industry classification and employment size, as in a typical CIS. Stratification will typically give results with smaller sampling errors than a non-stratified sample of the same size. The third and fourth columns of Table 1 show the number of firms in the target population in each stratum. For example, there are 1,926 firms with less than 10 employees in manufacturing of food, clothing, wood, paper, publishing and printing, corresponding to NACE codes 15-22. Further, initial samples are formed using simple random sampling with each stratum. Initial sample sizes are determined so as to ensure a reasonable final sample size allowing for non-response rates of 30-40%. Thus, the main rule is that the initial sample size is 104 firms in strata with micro-firms (less than 10 employees), and 66 firms in strata with small firms (10 to 49 employees). Two major exceptions are high-tech industries of "Post and telecommunications" (64) and "Computers and related activities" (72), where larger samples were drawn. Also, census is conducted in most high-tech strata where number of firms in the target population is rather small. For example, the number of micro-firms in "Manufacture of

[15] The main reason for not covering larger firms is that it is prohibitively expensive to conduct face-to-face interviews with owners of medium and large businesses.
[16] Anecdotal evidence suggests that mailed questionnaires are often delegated to accountants, secretaries, or interns.
[17] CIS questionnaires typically contain a brief standard definition.
[18] At the time of allocating the initial sample financial data were only available for 2006.

pharmaceuticals" (24.4) is only 19. Thus, all of these firms are included in the initial sample. In total, the size of initial sample is 2,754 firms.

Then, we used Business Registry to obtain the phone number and legal address of each firm in the initial sample. Also, we obtained the name and the last name of the owner and chair of the board of each firm. The market survey firm sought to interview a designated owner-manager for each firm in the initial sample. To boost the response rate, the first step was to send an official letter signed by the principal researcher at the Stockholm School of Economics in Riga, asking to participate in the survey. This was followed up by a phone call from the market research firm to arrange the date for the interview. The fieldwork began in September 2007 and 1,251 full interviews were completed by September 2008. The last two columns of Table 1 summarize the results of the survey in terms of the final sample sizes in each stratum. A major unexpected difficulty was that many firms, especially the smallest ones, could not be found at their official addresses. These difficulties are summarized in the last three columns of Table 2. The rate of contactable refers to the percentage of firms in the initial sample that could be located and contacted by the interviewers. On average, only 58% of the firms in the initial sample could be contacted. The contactable rate is the lowest for micro-firms – 54% of the initial sample. It ranged from 34% for micro-firms in "technical testing and analysis" (74.3) to 100% for small firms in "manufacture of pharmaceuticals" (24.4). However, the response rate was quite high among the firms that were contacted – on average, 86%. The response rates for different strata are summarized in the third, fourth, and fifth columns of Table 2. These range from 53% for small firms in "transport and storage" (60-63) to 100% for micro-firms in "manufacture of aerospace equipment" (35.3).

Finally, the survey data were merged with the financial and ownership data from the Business Registry. Specifically, SIBiL has data on the balance sheets and profit statements in 1996-2007, as well as ownership data for 2007.

4. First look at the data

After merging the survey data with the information from the Business Registry we clean the dataset. First, we delete observations with missing information on export-orientation or product innovation. Second, we delete two firms which are outliers in terms of a very remarkable growth in employment over 2005 to 2007 (probably because of merging with other companies). However, we do not delete several firms which experienced a moderate growth in employment (and therefore went beyond the threshold of 49 employees turning from small firms into medium-sized firms). The final sample consists of 1213 firms.

About 30% of the sample (368 firms) are exporters. Percentage of exporting firms varies greatly across the sectors (see Table 3): from slightly less than 3% in electricity, gas, and water supply (40-41) to more than 40% in manufacturing of transport equipment (34-35) and high-technology sectors - manufacturing of pharmaceuticals, office machinery, computers, electronics, communication and aerospace equipment (24.4, 30, 32, 35.5)[19] and computers and related activities (72). Table 4 shows that exporters are very heterogeneous in terms of intensity of exporting. Almost half of them are non-intensive exporters with less than 25% of sales from exported goods. On average they have about 10% of their sales abroad. However, another 30% of export-oriented firms export very intensively. On average more than 93% of their sales are generated by exports. Firms are more likely to export to the countries of the EU (including neighbor countries Estonia and Lithuania). Commonwealth of Independent States is the next important destination.

[Insert Table 3]

Slightly more than a half of the sample (643 firms) are the firms that introduced an innovative product during 2005-2007. As expected, the percentage of innovative firms is high in knowledge-intensive and high-technology sectors (more than 60%), and it is relatively low in traditional sectors, e.g. electricity, gas, and water supply (40-41).

Both innovative and export-oriented firms tend to be larger than 'regular' firms, judging by the number of employees. The latter are also slightly younger in comparison with regular firms. There are fewer sole owners among exporters and innovative firms and multiple owners are more frequent. Descriptive statistics on the characteristics of the firms and their owners are presented in Table 6.

[Insert Table 6]

The descriptive analysis shows that decisions to export and to undertake product innovation are interrelated. Among exporters there are significantly more firms with product innovations than among non-exporters. However, descriptive statistics provide no evidence on a positive relationship between export intensity and the degree of innovativeness of firms. The correlation between the share of sales from exports and the share of sales from innovative products is not particularly high – 0.12. There are no significant differences between the share of sales from innovative products for exporters and non-exporters as well as for exporters with different export intensity (see Table 4). Moreover, the percentage of innovative firms is higher among non-intensive exporters than among firms with high

[19] Each of these high-technology sectors has a very small sample size (of less than 30 observations). Therefore, in descriptive analysis they are merged into one group.

export-intensity. These findings point to the possibility of a negative link between export-orientation and innovativeness.

[Insert Table 4]

Almost 75% of the firms in the sample introduced either product or process innovation or had other ongoing or abandoned innovation activities, and thus were asked to assess the importance of different information sources for their innovation activities. It was assumed that for non-innovative firms information sources were not relevant for innovation activities. Table 5 summarizes descriptive statistics on the degree of importance of all information flows and obstacles to innovation listed in the questionnaire[20]. It appeared that "own enterprise or other enterprises in a group" is the source of information most frequently mentioned as very important. Other sources with relatively high importance are suppliers, customers and conferences. Universities, government and public research institutes are very rarely mentioned as highly important. As for obstacles to innovation, high costs, lack of funds, lack of qualified personnel as well as dominance of established enterprises are frequently mentioned as the most important. Few firms report lack of information on technology and markets to have high degree of importance.

[Insert Table 5]

In our analysis we pay a special attention to demographic characteristics of the owners, especially ethnicity. Table 6 report sample means for the characteristics of the owners in the sample. We focus on the characteristics of the largest owner, because approximately half of the firms in the sample are sole owners and most of firms have the largest owner individual. However, there are cases when the largest owner is a legal person (151 observations). In almost 30% of firms the largest owner is ethnic Russian, and in another 11% – the person of other ethnicity. Descriptive statistics show that ethnical background of the owners is different for the exporting firms and for the firms that supply only domestic market. The largest owner of an export-oriented firm is less likely to be ethnic Latvian and it is more frequently a person of other ethnicity. On the contrary, ethnical background of owners in innovative and non-innovative firms is found to be very similar.

[20] Because of suspected correlation between some factors and error term in export equation not all of them could be used as instrumental variables.

5. Results

5.1 Impact of innovation on exports

Table 7 shows the estimated results of the effect of innovativeness on export intensity, starting with single-equation OLS and Tobit models, following by Linear and Tobit models with instrumental variables and finishing with robustness checks.

[Insert Table 7]

Specification 1 fits a basic OLS model. This model does not account for simultaneous causality between exports and innovation and is estimated for comparison purposes. Estimates shows that innovativeness is positively correlated with exports – specifically, a one percentage point increase in the share of sales from innovative products raises the share of sales from exports by 0.08 percentage points. The magnitude of the estimated effect is thus not very large, but it is statistically significant.

Specification 2 adjusts the previous result for data censoring by fitting a Tobit model. The model reports coefficients, which shows the effect of regressors on the latent export intensity and can not be directly interpretable. We can see that the coefficient on innovativeness remains positive and statistically significant.

In terms of control variables, Specification 2 suggests that larger firms (i.e. those with a larger number of workers) tend to export more. This conforms to the theoretical conjecture regarding fixed costs of entering exports markets. The effect of the size appears to be non-linear with the quadratic term entering equation with a negative sign. It means that increase in size beyond some level have no positive impact on export behaviour. Furthermore, foreign-owned firms are, on average, far more active in foreign markets. The coefficient on this variable is very large pointing to the high impact of foreign ownership on export-intensity of the firm. The enterprises with two owners and enterprises with multiple owners appear to be more export-oriented than firms with sole owners. However these effects are significant only on the margin. Industry dummies are jointly statistically significant (with F-statistic 3.6). Finally, age of the firm and background of the largest owner do not seem to affect export orientation significantly.

Specification 3 accounts for endogeneity of innovativeness in export equation by estimating a linear model with instrumental variables. The degree of importance of different information sources is used to instrument innovativeness of firms. The F-test of excluded instruments shows that the instruments are fairly strong. Furthermore, Hansen's J-test of overidentifying restrictions gives no evidence of instrument endogeneity. The coefficient on innovations remains positive and significant. It is also substantially higher than the initial OLS estimate (0.17 vs 0.08), pointing to bias in OLS estimates arising from endogeneity of innovation.

Specification 4 takes into account both endogeneity and data censoring by fitting a two-step Tobit model. We use the same set of instruments as in Specification 3. The tests confirm that the instruments are fairly strong (with F-statistic equal to 9.54) and valid (with p-value of 0.15 in Hansen's J-test). The estimated coefficient on innovativeness is statistically significant and equal to 0.58. This estimate is much higher than the coefficient in naïve Tobit model with innovation treated as exogenous. It means that the coefficient in a single-equation model is downward-biased. Indirectly, this may indicate that the reverse effect of exports on innovativeness might be negative, i.e. firms that export more intensively tend to be less innovative.

Specifications 5-8 present the results of various robustness checks to address the potential caveats in our main model (Specification 4). In Specification 5, the initial set of instruments is replaced by an alternative one, namely, by a set of dummies showing the influence of different obstacles on innovation activities. F-test shows that theses instruments are not very strong (although they appear to be exogenous, judging from the J-test). This is likely to cause a large variance in the second-stage equation and is probably the reason why the coefficient on innovativeness is not statistically significant. Nevertheless, the point estimate of 0.65 is fairly close to the one in Specification 4, which confirms the robustness of the initial result.

Specification 6 uses both sets of instruments. Again, the estimated coefficient is close to the one reported in Specification 4, and it is also statistically significant. Instruments are weaker than in the main model (probably because of inclusion of the weak set of instruments), but they are still exogenous.

Specification 7 relaxes the implicit assumption that firms could objectively evaluate the importance of various information sources. It replaces the dummies showing the level of importance with dummies showing whether a particular source of information was relevant for a firm. The instruments are jointly significant, and no evidence of instrument endogeneity is found. The coefficient on the share of sales from innovative products remains statistically significant and is now estimated to be 0.51, which is again close to the initial estimate in Specification 4.

Finally, Specification 8 runs the main model on a sample of innovative firms only[21]. Our main instruments are constructed based on the assumption that information sources are not relevant for innovative activities of non-innovating firms. We check whether our results are robust to this assumption. The estimates in Specification 8 should be viewed cautiously, because instruments appear to be fairly weak in this specification (F-statistic equals 3.12), and the null hypothesis of instrument validity in J-test can not be rejected at 10% significance level but can be rejected at 5%. Nevertheless,

[21] Here innovative firms are defined as firms with innovative products or processes or having any other ongoing or abandoned innovative activities, i.e. all those firms that answered the question on information sources.

despite these problems, the estimated coefficient is still statistically significant and close in magnitude to our previous estimates, which supports the validity of the initial result.

Putting these results together, we can say that innovation appears to have a positive casual effect on export orientation of firms. In Specification 4 (with both endogeneity and data censoring taken into account) the coefficient on the share of sales from innovative products is equal to 0.579. This estimate is statistically significant at 1% level. This estimate is robust to relaxing various assumptions about our variables, and to replacing our instruments with an alternative set of variables. In all specifications the estimated coefficient on innovativeness ranges between 0.51 and 0.655, and remains statistically significant in all but one specification.

Table 8 shows the effects of innovation on exports to different destinations, estimated using IV Tobit in a manner similar to the main model (Specification 4).

[Insert Table 8]

We can see from the F-statistic that in all cases, instruments are fairly strong. Moreover, results of J-tests support the hypothesis that instruments are exogenous.

Looking at the estimated coefficients, we can observe that innovativeness positively affects exports to all destinations, but the magnitude of these effects differ. The effect of innovation on exports to Lithuania and Estonia is the weakest, while exports to other EU states and CIS are far more sensitive to innovative activities of the firm.

Furthermore, these regressions confirm our conclusion that foreign-owned firms tend to be more export-intensive. The magnitude of the coefficients differ by export destinations, pointing to the strongest effect of foreign ownership on exports to the EU, probably because many of the foreign-owned companies are owned by firms from other EU states. The effect of size of the firm is significant only in the regression for exports to the EU, suggesting that there are especially high costs of entering the EU market.

5.2 Impact of exports on innovation

Table 9 shows the estimated results of the effect of export intensity on innovativeness. In the first two columns single-equation models are presented, then follow the models with instrumental variables. The last column reports the results of a robustness check.

[Insert Table 9]

Specification 1 fits the OLS model. It suggests that without controlling for simultaneous causality, we can observe a positive correlation between innovativeness and export-orientation of firms. Specification 2, which estimates a Tobit model, shows a similar result.

A brief look at other coefficients shows that larger firms tend to innovate more, perhaps because innovation activities involve large fixed costs, such as establishing an R&D department. The significant negative quadratic term suggests a non-linear effect of the size of the firm (an inverted U-shape). Unlike export equation where the effect of firms' age was insignificant, in innovation equation younger firms appear to be more innovative. It may suggest that new firms are frequently established with a purpose of selling a novel product. Firms with multiple owners tend to be more innovative than firms with sole owners. Also the firms with the largest owner having higher education (as compared with secondary vocational) are found to be more innovative. It may suggest that having more owners or more educated owners leads to greater human capital and more diverse experiences and expertise that can be effectively used to develop innovations.

In Specification 3, we run a linear regression and control for the direction of causality by instrumenting exports with ethnicity of the largest owner. Tests show that the instruments are valid (Hansen's J-test yields a p-value of 0.51) and fairly strong (F-statistic equal to 8.50). When simultaneity is controlled for, the estimated coefficient becomes negative and is only significant at 10%.

Specification 4 adjusts the previously estimated regression by fitting an IV Tobit model to control for data censoring. We can see that the coefficient on exports remains negative and significant at 10% level. Specification 5, which restricts the sample to firms with only one owner, yields a similar result, although the magnitude of the coefficient becomes larger. In both cases, tests of overidentifying restrictions show that instruments are valid. Instruments appear to be fairly strong in the main IV Tobit model, although they are weaker when the model is run on a restricted sample.

To summarize our results regarding the effect of export intensity on innovativeness, we find no evidence of a positive impact of exports on innovation. In other words, the learning-by-exporting hypothesis cannot be confirmed. On the contrary, our results point to a possibility of a negative effect of exports on innovativeness. However, these findings should be viewed with caution because the instruments that we use are not very strong, and the significance level of estimated coefficients is not very high once causality and data censoring are controlled for.

6. Conclusions

In this paper we addressed the question of causality between innovativeness and export-orientation using data on innovative activities of Latvian firms. Our results suggest that there is a positive causal link from innovativeness to export intensity. However, we have found no evidence in support of the reversed positive causality from exports to innovativeness.

The extent of innovativeness of the firms, measured as the share of firms' sales from innovative products, has a positive and statistically significant effect on the share of sales generated by exported

goods, controlling for firm size, age, number of owners, industry and other important factors. This result is robust to a variety of different specifications of the model. Furthermore, it appears that the effect of innovativeness is different for exports to different destinations. Exports to CIS and EU countries are far more sensitive to innovativeness than sales to Lithuania and Estonia. At the same time, the effect of export intensity on innovation appeared to be negative and significant only on the margin.

These results provide support for self-selection mechanism as a tool to explain the link between exports and innovation. The paper finds no evidence in support of learning-by-exporting.

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Figure 1: Share of innovative products in total sales

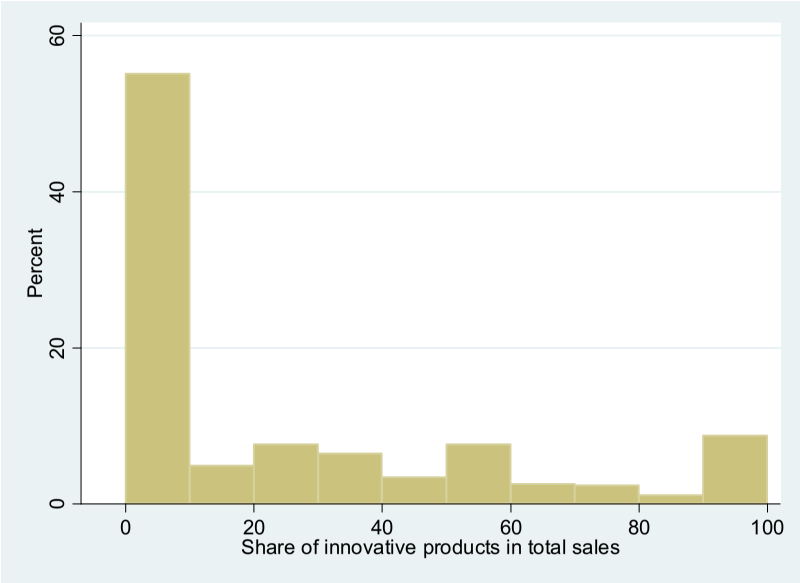

Figure 2: Share of exports in total sales

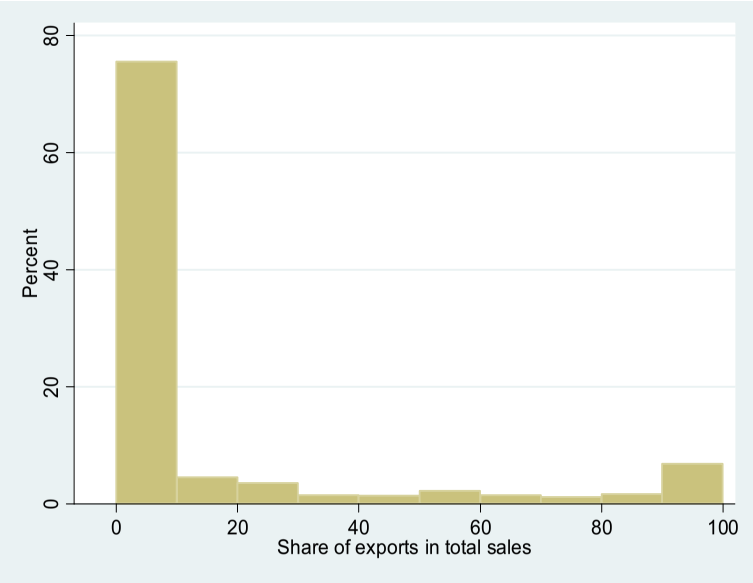

Table 1: Sampling strategy and final sample size

NACE (rev.1)	Industry	Target population		Projected sample size		Final sample size	
		Number of employees		Number of employees		Number of employees	
		<10	10-49	<10	10-49	<10	10-49
10-14	Mining and quarrying	37	38	37	38	17	11
15-22	Mfr of food, clothing, wood, paper, publishing and printing	1926	1354	104	66	52	45
23-29	Mfr of fuels, chemicals, plastics metals & minerals (except 24.4)	818	571	104	66	55	40
24.4	Mfr of pharmaceuticals	19	6	19	6	12	2
30	Mfr of office machinery and computer	35	13	35	13	16	9
31	Mfr of electrical machinery	54	24	54	24	29	11
32	Mfr of electronics and communications equipment	36	16	36	16	17	6
33	Mfr of scientific instruments	101	23	101	23	65	18
34-35	Mfr of transport equipment (except 35.3)	84	67	84	67	39	19
35.3	Mfr of aerospace equipment	3	2	3	2	2	1
36-37	Mfr not elsewhere classified	444	221	104	66	49	34
40-41	Electricity, gas and water supply	168	190	104	66	45	29
51	Wholesale trade	4797	2113	104	66	39	36
60-63	Transport & storage	2373	1199	104	66	52	13
64	Post & Telecommunications	219	68	219	68	71	33
65-67	Financial intermediation	418	101	104	68	42	21
72	Computer & related activities	833	137	155	137	80	67
73	Research and Development	82	13	82	13	43	8
74.2	Architectural & engineering activities	631	210	104	68	54	15
74.3	Technical testing and analysis	101	57	101	57	37	17

Table 2: Percentage of valid contacts and response rate

NACE (rev.1)	Industry	Percentage of valid contacts in projected sample [a]			Response rate [b]		
		Number of employees			Number of employees		
		<10	10-49	total	<10	10-49	total
10-14	Mining and quarrying	57%	79%	63%	90%	100%	94%
15-22	Mfr of food, clothing, wood, paper, publishing and printing	49%	74%	59%	92%	94%	93%
23-29	Mfr of fuels, chemicals, plastics metals & minerals (except 24.4)	56%	73%	63%	85%	85%	85%
24.4	Mfr of pharmaceuticals	74%	100%	80%	86%	33%	70%
30	Mfr of office machinery and computer	57%	100%	69%	80%	77%	79%
31	Mfr of electrical machinery	62%	71%	64%	88%	92%	89%
32	Mfr of electronics and communications equipment	64%	63%	63%	70%	70%	70%
33	Mfr of scientific instruments	70%	83%	72%	89%	90%	89%
34-35	Mfr of transport equipment (except 35.3)	49%	79%	58%	98%	88%	94%
35.3	Mfr of aerospace equipment	67%	100%	80%	100%	50%	75%
36-37	Mfr not elsewhere classified	42%	72%	53%	100%	93%	96%
40-41	Electricity, gas and water supply	47%	58%	51%	92%	88%	90%
51	Wholesale trade	54%	58%	56%	87%	78%	82%
60-63	Transport & storage	52%	43%	49%	91%	53%	78%
64	Post & Telecommunications	54%	76%	62%	91%	85%	88%
65-67	Financial intermediation	52%	62%	55%	72%	76%	74%
72	Computer & related activities	61%	66%	63%	80%	81%	81%
73	Research and Development	57%	85%	60%	87%	91%	88%
74.2	Architectural & engineering activities	58%	30%	47%	85%	90%	86%
74.3	Technical testing and analysis	36%	70%	43%	100%	89%	96%
	All industries	54%	65%	58%	87%	83%	86%

Notes: [a] Percentage of valid contacts is calculated as number of interviews and refusals divided by total number of contacts.
[b] Response rate is calculated as number of interviews divided by total number valid contacts.

Table 3: Percentage of exporters and firms with product innovation by industry

NACE (rev.1)	Industry	All firms		Exporters			Firms with product innovation		
		Number of observations	Percentage out of total	Number of observations	Percentage within industry	Share of sales from exported goods (if export)	Number of observations	Percentage within industry	Share of sales from innovative products (if innovate)
10-14	Mining and quarrying	27	2.23	5	18.5	54.2	11	40.7	30.0
15-22	Mfr of food, clothing, wood, paper, publishing and printing	96	7.93	35	36.5	41.9	51	53.1	40.5
23-29	Mfr of fuels, chemicals, plastics metals & minerals (except 24.4)	90	7.43	29	32.2	44.1	42	46.7	45.8
24.4, 30, 32, 35.3	Mfr of pharmaceuticals, office machinery, computers, electronics, communications and aerospace equipment [a]	65	5.37	27	41.5	43.4	42	64.6	45.9
31	Mfr of electrical machinery	36	2.97	13	36.1	60.0	18	50.0	25.6
33	Mfr of scientific instruments	75	6.19	22	29.3	37.5	62	82.7	42.5
34-35	Mfr of transport equipment (except 35.3)	58	4.79	26	44.8	57.3	26	44.8	45.9
36-37	Mfr not elsewhere classified	80	6.61	28	35.0	35.9	39	48.8	37.0
40-41	Electricity, gas and water supply	71	5.86	2	2.8	5.5	20	28.2	29.7
51	Wholesale trade	79	6.52	21	26.6	35.2	39	49.4	32.8
60-63	Transport & storage	65	5.37	26	40.0	57.6	21	32.3	34.3
64	Post & Telecommunications	96	7.93	16	16.7	58.4	66	68.8	48.7
65-67	Financial intermediation	62	5.12	13	21.0	53.9	30	48.4	33.9
72	Computer & related activities	144	11.89	60	41.7	33.5	99	68.8	48.3
73	Research and Development	49	4.05	19	38.8	54.1	27	55.1	71.1
74.2	Architectural & engineering activities	70	5.78	11	15.7	44.9	25	35.7	40.0
74.3	Technical testing and analysis	48	3.96	14	29.2	29.4	24	50.0	50.1

Notes: [a] These high-technology sectors are merged into one group because separately each of them has a very small sample size.

Table 4: Percentage of exporters and firms with product innovation by export destination and export intensity

Firms by export-orientation	Number of observations	Percentage out of total	Percentage within exporters	Share of sales abroad (if export [a])	Percentage of firms with product innovation	Share of sales from innovative products (if product innovation is introduced)
Non-exporters	845	69.7	-	0.0	46.5	41.9
Exporters	368	30.3	100.0	44.0	67.9	45.7
by export destination:						
Estonia and Lithuania	196	16.2	53.3	16.0	74.5	43.1
Other EU	214	17.7	58.2	37.2	66.8	47.7
CIS countries	124	10.2	33.7	32.4	64.5	50.7
Other countries	45	3.7	12.2	24.0	80.0	51.3
by export intensity:						
low (1-24% of sales abroad)	163	13.4	44.3	9.6	74.2	40.6
medium (25-49%)	42	3.5	11.4	33.7	69.0	50.4
high (50-74%)	55	4.5	14.9	57.4	65.5	47.3
very high (75-100%)	108	8.9	29.3	93.1	59.3	52.5

Notes: [a] Mean share of sales abroad to specific destination is estimated on a sample of those firms that have non-zero export to this particular destination.

Table 5: Descriptive statistics on information flows and obstacles to innovation

Factors	Degree of importance				Number of observations
	high	medium	low	not relevant	
Information flows					
Family and friends	9.8	14.7	14.2	61.3	1201
Your enterprise or enterprise group	46.0	17.7	6.5	29.9	1192
Suppliers of equipment, materials, software etc.	31.3	22.2	10.2	36.3	1195
Client or customer	37.1	19.8	11.4	31.7	1200
Competitors or other enterprises in your sector	22.9	23.6	18.0	35.5	1199
Consultants, commercial labs or private R&D institutes	6.0	13.1	17.5	63.4	1190
Universities or other higher education institutions	4.3	11.8	15.3	68.5	1199
Government or public research institutes	2.7	8.7	12.9	75.6	1190
Conferences, trade fairs, exhibitions	26.2	22.0	11.2	40.6	1201
Scientific journals and technical publications	19.8	26.3	12.7	41.3	1199
Professional and industrial associations	6.0	12.1	13.1	68.7	1196
New employees	7.3	18.7	18.6	55.5	1195
Obstacles to innovation					
Lack of funds within your enterprise	35.5	20.2	23.2	21.1	1191
Lack of finance from external sources	25.9	16.5	27.5	30.2	1190
Too high innovation costs	37.8	25.0	22.8	14.4	1180
Lack of qualified personel	30.0	21.3	30.2	18.5	1195
Lack of information on technology	4.9	10.0	49.5	35.6	1193
Lack of information on markets	6.1	14.7	46.7	32.4	1196
Difficulty of finding cooperation partners for innovation	11.9	17.2	36.9	33.9	1180
Market is dominated y established enterprises	22.9	26.9	31.1	19.1	1179
Uncertain demand for innovative products	10.2	18.9	40.5	30.5	1171
No need for innovation due to prior innovations	4.8	9.8	50.8	34.6	1097
No need for innovation because of no demand for innovations	8.1	11.1	47.2	33.5	1097

Table 6: Descriptive statistics on characteristics of firms and owners: sample means

	Number of observations	All firms	Firms by export orientation			Firms by innovativeness		
			non-exporters	exporters	test for differences in means (p-value)	no product innovation	with product innovation	test for differences in means (p-value)
Characteristics of the firm								
Number of employees	1190	12.724	11.385	15.798	0.000	10.921	14.325	0.000
Micro firm (< 10 employees)	1186	0.572	0.622	0.457	0.000	0.627	0.523	0.000
Small firm (10-49 employees)	1186	0.400	0.355	0.501	0.000	0.355	0.439	0.003
Medium firm (50-249 employees)	1186	0.029	0.023	0.042	0.079	0.018	0.038	0.038
Number of owners	1195	2.001	1.938	2.141	0.247	1.874	2.111	0.144
Sole owners	1195	0.552	0.590	0.467	0.000	0.596	0.514	0.005
Partnerships	1195	0.254	0.238	0.291	0.054	0.244	0.263	0.449
Three owners or more	1195	0.193	0.172	0.242	0.005	0.160	0.223	0.006
Age of the firm	1213	10.062	10.102	9.970	0.627	10.365	9.793	0.022
Characteristics of the owners								
At least one foreign owner	1213	0.136	0.093	0.234	0.000	0.109	0.160	0.009
The largest owners is legal person	1168	0.129	0.121	0.149	0.178	0.137	0.122	0.455
Ethnicity of the largest owner:								
Latvian	1122	0.459	0.485	0.401	0.009	0.452	0.465	0.648
Russian	1122	0.293	0.297	0.284	0.640	0.287	0.298	0.683
Other	1122	0.113	0.092	0.161	0.001	0.119	0.108	0.556
Education of the largest owner:								
Secondary general or less	1101	0.035	0.028	0.053	0.033	0.041	0.031	0.356
Secondary professional	1101	0.177	0.197	0.133	0.011	0.201	0.156	0.356
Bachelor degree	1101	0.470	0.499	0.405	0.004	0.468	0.473	0.870
Master or doctoral degree	1101	0.180	0.148	0.251	0.000	0.144	0.211	0.004

Table 7: Impact of innovativeness on export-orientation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Model	OLS	Tobit	IV Linear	IV Tobit	IV Tobit	IV Tobit	IV Tobit	IV Tobit
Dependent variable	Share of sales from exports	Share of sales from exports	Share of sales from exports	Share of sales from exports	Share of sales from exports	Share of sales from exports	Share of sales from exports	Share of sales from exports
Share of sales from innovative products	0.0799**	0.341***	0.169**	0.579***	0.646	0.619***	0.510**	0.655***
	(0.0328)	(0.0963)	(0.0731)	(0.190)	(0.642)	(0.192)	(0.253)	(0.252)
Number of employees	0.164	0.967***	0.183	0.933***	0.839**	0.867**	1.008***	0.718**
	(0.117)	(0.343)	(0.116)	(0.349)	(0.407)	(0.351)	(0.359)	(0.357)
(Number of employees)^2	-0.000402	-0.00559*	-0.000602	-0.00538*	-0.00458	-0.00489	-0.00584*	-0.00324
	(0.00103)	(0.00316)	(0.00101)	(0.00317)	(0.00362)	(0.00320)	(0.00327)	(0.00309)
At least one foreign owner	14.41***	42.06***	14.12***	39.07***	40.56***	37.13***	40.40***	33.03***
	(3.397)	(8.221)	(3.417)	(8.130)	(8.400)	(8.253)	(8.329)	(8.947)
Age of the firm	-0.138	-0.495	-0.0910	-0.278	-0.00335	-0.00619	-0.374	-0.805
	(0.206)	(0.679)	(0.212)	(0.698)	(0.955)	(0.711)	(0.730)	(0.778)
Partnership	5.041**	16.85**	5.482**	16.95***	14.15*	15.24**	18.11***	15.51**
	(2.144)	(6.745)	(2.145)	(6.576)	(7.239)	(6.702)	(6.750)	(6.945)
Multiple owners	3.469	13.58*	3.387	11.67	7.129	7.772	13.13*	4.025
	(2.354)	(7.514)	(2.505)	(7.608)	(9.080)	(7.754)	(7.823)	(8.179)
The largest owner has secondary general or lower education	5.045	27.97*	4.098	19.05	28.22*	18.98	20.94	29.51
	(5.593)	(15.58)	(5.658)	(15.76)	(16.44)	(15.99)	(16.11)	(18.06)
The largest owner has higher education	0.962	8.940	-0.494	3.633	7.289	3.483	4.716	10.40
	(2.251)	(8.441)	(2.298)	(8.187)	(9.250)	(8.384)	(8.405)	(9.407)
The largest owners is a legal person	5.267	18.36	5.350	16.17	17.85	15.85	18.21	23.15*
	(3.663)	(11.90)	(3.729)	(11.26)	(11.98)	(11.48)	(11.52)	(13.00)
Constant	7.125*	-64.49***	3.999	-64.44***	-70.59***	-65.28***	-68.37***	-55.68***
	(3.907)	(13.21)	(4.138)	(14.04)	(18.43)	(14.31)	(14.77)	(16.13)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instruments	No	No	Information sources	Information sources	Obstacles	Information sources and obstacles	Information sources (alternative definition)	Information sources
F-statistic on joint instrument significance			10.40	9.54	1.92	6.93	17.45	3.12
Test of overidentifying restrictions (p-value)			0.3293	0.1508	0.2557	0.1278	0.1229	0.0862
Number of uncensored observations		272		260	258	247	260	212
Number of observations	1028	1028	983	983	982	940	983	712

*Note: *** denotes significance level at 1%, ** 5%, * 10%.*

Table 8: Impact of innovativeness on exports to different destinations

	(1)	(2)	(3)
Model	IV Tobit	IV Tobit	IV Tobit
Dependent variable	Share of sales from exports to other Baltic States	Share of sales from exports to other EU	Share of sales from exports to CIS
Share of sales from innovative products	0.260***	0.531**	0.491*
	(0.0981)	(0.214)	(0.265)
Number of employees	0.00682	1.316***	0.152
	(0.172)	(0.451)	(0.470)
(Number of employees)^2	0.000479	-0.00912*	0.000471
	(0.00144)	(0.00515)	(0.00389)
At least one foreign owner	12.13***	37.63***	17.77*
	(4.052)	(9.041)	(10.68)
Age of the firm	0.472	-0.142	-0.449
	(0.362)	(0.791)	(0.974)
Partnership	5.963*	14.25*	15.58*
	(3.345)	(7.572)	(8.974)
Multiple owners	1.915	9.270	16.67
	(3.893)	(8.647)	(10.33)
The largest owner has secondary general or lower education	6.336	16.61	6.170
	(8.409)	(17.09)	(22.30)
The largest owner has higher education	7.509*	-6.693	19.17
	(4.443)	(9.320)	(12.33)
The largest owners is a legal person	10.71*	6.444	18.37
	(5.858)	(12.61)	(16.31)
Constant	-54.72***	-69.01***	-100.6***
	(8.797)	(16.03)	(21.37)
Industry dummies	Yes	Yes	Yes
Instruments	Information sources	Information sources	Information sources
F-statistic on joint instrument significance	9.54	9.54	9.54
Test of overidentifying restrictions (p-value)	0.4352	0.1210	0.7444
Number of uncensored observations	156	151	99
Number of observations	983	983	983

*Note: *** denotes significance level at 1%, ** 5%, * 10%.*

Table 9: Impact of export-orientation on innovativeness

	(1)	(2)	(3)	(4)	(5)
Model	OLS	Tobit	IV Linear	IV Tobit	IV Tobit
Dependent variable	Share of sales from innovative products	Share of sales from innovative products	Share of sales from innovative products	Share of sales from innovative products	Share of sales from innovative products
Share of sales from exports	0.0985**	0.219**	-0.587*	-1.303*	-2.202*
	(0.0401)	(0.0853)	(0.324)	(0.709)	(1.258)
Number of employees	0.280**	0.687**	0.422***	0.975***	1.094*
	(0.120)	(0.267)	(0.159)	(0.352)	(0.664)
(Number of employees)^2	-0.00220**	-0.00500**	-0.00282**	-0.00622**	-0.00468
	(0.000931)	(0.00224)	(0.00141)	(0.00306)	(0.00834)
At least one foreign owner	-2.837	-4.912	6.552	16.42	30.75
	(2.788)	(6.555)	(5.444)	(12.77)	(21.96)
Age of the firm	-0.912***	-2.147***	-1.095***	-2.526***	-1.922*
	(0.228)	(0.539)	(0.295)	(0.650)	(1.039)
Partnership	2.167	4.139	5.236*	11.31	
	(2.162)	(5.051)	(3.090)	(7.027)	
Multiple owners	6.041**	13.61**	9.080***	20.14***	
	(2.710)	(5.998)	(3.448)	(7.544)	
The largest owners is a legal person	5.092	11.60	8.988*	19.95*	26.55
	(3.421)	(8.724)	(4.720)	(10.96)	(18.77)
The largest owner has secondary general or lower education	0.755	-2.320	4.732	6.799	16.80
	(5.175)	(14.50)	(6.978)	(16.47)	(28.96)
The largest owner has higher education	5.956**	15.47**	6.922**	17.14**	20.27*
	(2.336)	(6.037)	(2.779)	(7.268)	(11.49)
Constant	17.45***	-11.21	22.95***	0.255	0.341
	(4.231)	(10.21)	(5.791)	(13.59)	(23.07)
Industry dummies	Yes	Yes	Yes	Yes	Yes
Instruments	No	No	Ethnicity of the largest owner	Ethnicity of the largest owner	Ethnicity of the largest owner
F-statistic on joint instrument significance			8.50	9.29	4.72
Test of overidentifying restrictions (p-value)			0.5085	0.7044	0.3080
Number of uncensored observations		415		405	210
Number of observations	1028	1028	1009	1009	562

Note: *** denotes significance level at 1%, ** 5%, * 10%.

Appendix A: SIBiL Questionnaire (Selected questions)

EXPORT-ORIENTATION

B4. Over the last two to three years of operation, what percent of your sales was in
IWER: If R finds it difficult to answer the question, ask to provide an estimate.
Check that the sum of all the percentages mentioned sums up to 100%

Country	**%**
1. Latvia	
2. Lithuania and Estonia	
3. Other EU countries	
4. CIS member countries (i.e. Russia, Belarus, Ukraine, Armenia, Azerbaijan, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Uzbekistan, and Georgia)	
5. Other countries	

PRODUCT INNOVATION

READ: The purpose of our survey - obtain information only on innovation or innovations for three years (2005-2006-2007). We begin with the innovations in products (goods and services). Here we define product innovation as an introduction of a new good or service or a significantly improved good or service. **The innovation (whether completely new or improved) must be novel to your enterprise, but it doesn't necessarily need to be new to your sector or market.** Thus, simple resale of new goods purchased from other enterprises and changes of a solely aesthetic nature here are not considered innovations. It doesn't matter, however whether the innovation was originally developed by your enterprise or by other enterprises.

C1. During the three years 2005 to 2007, did your enterprise introduce new or significantly improved goods or services?
IWER INFO: If R finds it difficult to answer this question, please provide assistance using the following definitions and industry specific examples from the Oslo manual.

1. YES
2. NO ➔ go to C7

C3. Were any of your goods and/or services innovations during the 2005 to 2007:

	Yes	**No**	**Don't know/NA**
1. New to your market? -Your enterprise introduced a new or significantly improved good or service onto your market before your competitors (if may have already been available in other markets)	1	2	9
2. Only new to your firm? – Your enterprise introduced a new or significant improved good or service that was already available from your competitors in your market	1	2	9

C4. Please give the percentage of your total turnover in 2007 from:

Goods and service innovations introduced during 2005 to 2007 that were **new to your market**	%
Goods and service innovations introduced during 2005 to 2007 that were **only new to your firm**	%
Goods and services that **were unchanged or only marginally modified** during 2005 to 2007 (include the resale of new goods or services purchased from other enterprises)	%
Total turnover in 2007:	**100**%

SOURCES OF INFORMATION FOR INNOVATION ACTIVITIES

C24. During the three years 2005 to 2007, how important to your enterprise's innovation activities were each of the following information sources? SHOW CARD

Please identify information sources that provided information for new innovation projects or contributed to the competition of existing innovation projects

Information source		Degree of importance				
		High	Average	Low	Not used	Don't know/NA
Internal	**A** Family or friends	1	2	3	4	9
	B Within your enterprise or enterprise group	1	2	3	4	9
Market source	**C** Suppliers of equipment, materials, components, or software	1	2	3	4	9
	D Client or customer	1	2	3	4	9
	E Competitors or other enterprises in your sector	1	2	3	4	9
	F Consultants, commercial labs, or private R&D institutes	1	2	3	4	9
Institutional sources	**G** Universities or other higher education institutions	1	2	3	4	9
	H Government or public research institutes	1	2	3	4	9
Other sources	**I** Conferences, trade fairs, exhibitions	1	2	3	4	9
	J Scientific journals and technical publications	1	2	3	4	9
	K Professional and industrial associations **L** New employees	1	2	3	4	9

OBSTACLES TO INNOVATION

C30. During the three years 2005 to 2007, how important were the following factors for hampering your innovation activities or projects or influencing a decision not to innovate? SHOW CARD

		Degree of influence				
		High	Medium	Low	Not relevant	Don't know/NA
Cost factors	**A** Lack of funds within your enterprise or group	1	2	3	9	9
	B Lack of finance from sources outside your enterprise	1	2	3	9	9
	C Innovation costs too high	1	2	3	9	9
Knowledge factors	**D** Lack of qualified personnel	1	2	3	9	9
	E Lack of information on technology	1	2	3	9	9
	F Lack of information on markets	1	2	3	9	9
	G Difficulty in finding cooperation partners for innovation	1	2	3	9	9
Market factors	**H** Market dominated by established enterprises	1	2	3	9	9
	I Uncertain demand for innovative goods or services	1	2	3	9	9
Reasons not to innovate	**J** No need due to prior innovations	1	2	3	4	9
	K No need because of no demand for innovations	1	2	3	4	9